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# Health career exploration through science, technology, engineering, and mathematics pipeline programming

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Developing effective programs that aim to generate student interest in the pursuit of a career in healthcare is vital to avoid shortages among the workforce. As the American population ages, the country will continue to experience a higher demand for healthcare-trained individuals and services. Exposing racially diverse students to career options and the educational requirements early can serve as a pipeline for increasing interest in obtaining careers in healthcare professions overall. Program formatting resembles “summer camps” as it provides students with educational opportunities outside of the typical school curriculum. These summer camp designed “programs” have been an effective method of increasing interest because it can provide hands-on exposure to healthcare careers, an opportunity to job shadow, and tour local healthcare facilities. Summer camps aimed to fill the gaps and increase interest in healthcare careers for underrepresented minority students. The literature identifies a few exploration camps across the United States, each with a data collection method unique to the program. This study examines the impact a summer health exploration camp can have on student efficacy and the effectiveness of generating student interest, in diverse populations, in the pursuit of a health-related career.

## KEYWORDS

diversity, pipeline, education, health professions, STEM

## Introduction

According to the Population Reference Bureau, there were 52 million Americans aged 65 and older in 2018 and by 2060 this population will almost double to 95 million (Population Reference Bureau [PRB], 2019). Roughly 80% of older adults have one form of chronic disease and 77% of older adults have been diagnosed with at least two chronic

diseases (National Council of Aging [NCOA], 2015). Heart disease, cancer, stroke, and diabetes account for about 66% percent of all deaths each year among all chronic diseases (National Council of Aging [NCOA], 2015). Approximately 1 out of 4 Americans aged 65 or older has been diagnosed with diabetes putting that population at an increased risk for heart disease and stroke (National Council of Aging [NCOA], 2015; U.S. Bureau of Labor Statistics [BLS], 2019). According to the United States Census, approximately 2/3 of the healthcare workers are non-Hispanic whites, while only 1/4 were individuals who are African American (Wallace et al., 2015).

As the population of older adults grows, healthcare-trained individuals and services will be in greater demand (Population Reference Bureau [PRB], 2019). Across the country, communities are at risk for shortages in the healthcare workforce due to the increase in the population of older adults, as well as a diverse makeup of healthcare providers. In order to keep up with the accelerated demand of healthcare professionals in the United States, the Bureau of Labor Statistics predicts careers in the health industry will grow by 16% in the 10-year span of 2020–2030, which would result in over 2.6 million new jobs (U.S. Bureau of Labor Statistics [BLS], 2019). To meet the increased demand for a more diverse healthcare workforce and to avoid the devastating consequences that result in a shortage of workings in the healthcare industry, the recruitment of young individuals to pursue health-related careers is of critical importance. A myriad of strategies has been developed to expose youth to careers in healthcare nationwide. One successful intervention strategy is through the form of “summer camps” as a method to provide information to students about careers in health (Matutina, 2008; Lauver et al., 2011). These exploration camps can be operated in a variety of venues, most notably hosted by hospitals, universities, and colleges (Lauver et al., 2011). The literature indicates that early exposure to careers is associated with student interest in pursuing a career in that field.

## Student interest

Exploring examples of student interest, The *HealthCare Academy for Middle School Pupils' Success (HCAMPS)* is a 5-day exploration experience for seventh-grade students from Evansville, Indiana (Moutseous and Heckel, 2013). The program was developed from a collaborative effort between community stakeholders including the public school system and the Southwest Indiana Area Health Education Center. The objectives of the *HCAMPS* program focused on exposure to health career job opportunities, the academic requirements for healthcare careers, and for students to create their own personal wellness plan. The pacing of the camp was designed to mimic a health professions education program, as participants receive an ID badge and

white coats immediately. Throughout the 5-day experience, participants are provided hands-on activities such as cow heart dissection, blood lipid panel, CPR training, and a fitness test. Participants are provided a variety of tours through simulation labs, a Neonatal Intensive Care Unit, and tours of the University of Southern Indiana, University of Evansville, and Ivy Tech Community College. A pre and post-test was administered to evaluate student interest in pursuing a career in healthcare professions. Results from the 2012 *HCAMPS* cohort found there was a 23% increase in students responding as “highly likely” to pursuing a career in health sciences (Moutseous and Heckel, 2013).

The positive trend in student interest upon completion of an exploration camp is seen throughout the literature. One example is an educational program designed to encourage underserved New Hampshire middle school students to seek careers in health sciences. The intervention focused on providing an interactive, hands-on curriculum, for underrepresented minority 7th graders in an effort to increase diversity and cultural competency in the health professions workforce (Grand Valley State University, 2022). The program is composed of three interactive modules, and the camp participants were able to have one on one conversations with professors and students in the pharmacy or physician assistant departments (Grand Valley State University, 2022). The participants were shown how to take blood pressure and pulse readings and check reflexes from the clinical exploration (Grand Valley State University, 2022). While in the pharmacy laboratory, participants were able to compound medicine-free gummy bears under the instruction of the pharmacy students (Grand Valley State University, 2022). Similar to the *HCAMPS* program, a pre and post-test was administered to measure knowledge pertaining to pharmacy and physician assistant and participant interest in healthcare careers. Knowledge in pharmacy and physician assistant careers increased significantly (42% pre-test to 89% post-test). Concluding that participation in activities that increase a student's knowledge of the topic impacted student interest in pursuing a healthcare career, which within the study increased marginally (Grand Valley State University, 2022).

Exploration camps have also been tailored to generate interest in science, technology, engineering, and mathematics (STEM). Interest and competence in STEM disciplines are often lacking for many students (Mohr-Schroeder et al., 2014; Phelan et al., 2017). In an effort to combat this trend the *See Blue STEM Camp* was developed to provide middle school students with engaging and hands-on experiences to encourage students to cultivate interest in STEM. Similar to the results observed in student exposure to health career exploration camps, the literature states that student interest in STEM results in a greater likelihood they pursue STEM degrees (Mohr-Schroeder et al., 2014; Phelan et al., 2017). The 2-week program *See Blue STEM Camp* provides engaging

activities for 5th through 8th-grade students to spark interest in STEM disciplines highlighting eight mathematical practices and eight science and engineering practices. Previous session topics include “Exploration of Physiology and Its Application to Crustaceans,” “Got Brains? A Journey through the Human Mind” and “Astronomy- The Vastness of Outer Space and a Deeper Look at the Milky Way” (Mohr-Schroeder et al., 2014). Data was collected by administering a pre-test and post-test questionnaire that assessed student attitudes and interest in STEM. Overall, the data showed that students wanted to learn more about STEM due to the *See Blue STEM Camp* experience, and over 90% of the students remarked that the sessions were “fun” and “interesting” (Mohr-Schroeder et al., 2014).

## Student retention and efficacy

The methods of data collection in exploration camps are unique to each program. *Blue STEM Camp* and *HCAMP* utilized survey evaluation tools to assess participant interest in STEM + healthcare disciplines to encourage students to pursue careers in those disciplines. These camps serve as a pipeline for students to follow their burgeoning interest in healthcare fields. Other camps seek to assess student attainment of health knowledge learned at camp for program evaluation. *Broadening Access to Science Education (BASE) Camp* is a 2-week summer STEM + healthcare focused exploration camp that targets high school girls in one of the most economically depressed cities in Connecticut (Phelan et al., 2017). *BASE Camp* provides high school girls with the opportunity to explore STEM and healthcare occupations and their corresponding educational requirements. STEM and healthcare professionals speak with the campers in small group sessions to talk about their academic paths. Campers tour a local hospital and a pharmaceutical company where they can have one on one conversations with female health scientists and health professionals (Phelan et al., 2017). Participants have the opportunity to work on science research projects with current undergraduate students during the first week of camp based on the expertise of the faculty. Neuroscience, psychology, engineering, and biology research topics are covered. The research projects extend into the second week of camp, but shift focus to writing and discussion (Phelan et al., 2017). Camp participants work with Fairfield University’s undergraduate admission counselors for college application support.

Students learn about the standardized testing required for college, suggested coursework, and receive information on how to search for colleges. During the second week of camp, parents are invited to join for dinners and are able to receive information about college admissions and financial aid.

*BASE Camp* is unique because the entire staff, faculty, and undergraduate STEM majors are female. Students are given a pre and post-test in which they state how high they believe their understanding or knowledge is for certain topics. The students showed an increase from the pre to the post-test for understanding the scientific process, knowledge of the skills required to succeed in science, knowledge of the responsible and ethical way to conduct research, knowledge about the college admissions process, and knowledge of the skills required to succeed in college (Phelan et al., 2017). The questions about student efficacy after the camp, showed significant increases (8–12%) in all but one post-camp ratings (Phelan et al., 2017). The University of Detroit Mercy School of Dentistry conducts a program specifically for 7th- and 8th-grade students to explore careers in dentistry, obtain oral health education, and introduce them to role models (Mayberry et al., 2018). The University offers two programs, *Urban Impressions*, and *Dental Imprint*. *Urban Impressions* consists of 4 sessions that span over the course of 2 years. Participants are introduced to and engaged with dentistry knowledge and techniques. *Urban Impressions* involves instruction of oral health, tours of the dental school, school visits by dental professionals, and hands-on laboratory simulation. This program only assesses student interest but *Dental Imprint* assesses student interest and student knowledge. *Dental Imprint* offers cultural awareness workshops, dental career pathway presentations, and a local dentist and dental student panel. Students are given a pre-test gauging student knowledge of dental anatomy, caries etiology, dental specialties, dental admission requirements, and oral hygiene care. Student knowledge significantly improved after the sessions, as student post-test scores went from 44.8 to 71.2% (Mayberry et al., 2018).

*Careers in Health and Medical Professions (CHAMPS)* offers high school students an opportunity to explore careers in healthcare while simultaneously improving their knowledge in science and math (Wallace et al., 2015). The 2-week program aims to serve as a pipeline for underrepresented minorities to transition into health field professionals. The curriculum focuses on developing problem-solving with research and team-building with group projects. Throughout the 2-week program, participants are exposed to topics like microscopy, antibiotics, bioethics, and epidemiology (Phelan et al., 2017). They also complete an assessment evaluating their knowledge of science and medical concepts and careers. The results of this assessment show significant gains for each grade level each year in science and medical concepts knowledge (Wallace et al., 2015).

Grand Valley State University offers *Summer Health Activities and Professions Exploration (sHaPe)* Camp designed to introduce underrepresented, minority middle school students to the healthcare professions with a goal of helping to increase student interest in their (primarily) first generation target audience and helping to pipeline minority populations

in the healthcare workforce in Michigan ([Grand Valley State University, 2022](#)).

## Methods

The recruitment, assessment, and analysis of effectiveness for many summer health exploration camps follow a typical structure as seen throughout the literature. Participants are most often recruited by utilizing partnerships with local school districts to disseminate resources and information on the upcoming camp. Both *Careers in Health and Medical Professions (CHAMPS)* and *Blue STEM Camp* provided fliers and additional resources such as application requirements and informational websites to the students through newsblasts and short presentations given by teachers ([Mohr-Schroeder et al., 2014](#); [Wallace et al., 2015](#)). In all instances, interested participants were asked to fill out and submit an application. The requirements for applications varied by exploration camp, though typically required consent from a guardian, information on the student's academic background, and a statement or essay of interest ([Moutseous and Heckel, 2013](#); [Mohr-Schroeder et al., 2014](#); [Wallace et al., 2015](#); [Phelan et al., 2017](#); [Grand Valley State University, 2022](#)). Once selected, students were invited to attend the summer exploration camp which provided opportunities to explore health or STEM related fields of study.

Participants in the summer exploration camps were typically administered a pre-test on the first day of the exploration camp and a post-test at the conclusion of the camp in order to measure attitudes and perceptions about personal health, pursuing a college education, interest, and perceived efficacy in obtaining a health career. The majority of the pre and post-tests reviewed were identical, presenting the same statements to be ranked on a Likert scale before and after participation in camp activities. Included statements on these surveys were designed to measure an individual's attitudes on various health or STEM-related topics, such as, "I have an interest in a career in the STEM field" as seen in the *CHAMPS* pre- and post-surveys ([Wallace et al., 2015](#)). Post-tests may also have an open-ended student feedback segment for students to express their attitudes in a less structured manner. Additionally, many summer exploration camps measure student interest after each educational session with short, open-ended questionnaires, for example, the *Blue STEM Camp* ([Mohr-Schroeder et al., 2014](#)).

Data collected in each of these studies from participants that attended summer exploration camps were used to determine the effectiveness of the camps and to understand how the camp impacts a diverse populations' attitudes about personal health, pursuing a career in healthcare and perceived participant efficacy. Utilizing the responses from pre- and post-camp surveys, the data are analyzed to measure changes in attitudes and perceptions. Common strategies to quantify changes in Likert scale responses include paired *t*-tests on means or

Wilcoxon signed-ranks tests ([Mohr-Schroeder et al., 2014](#); [Wallace et al., 2015](#)). ANOVA tests were also used to analyze responses by group ([Wallace et al., 2015](#)). For camps that obtained open-ended responses on post-tests or through interviews, participants' answers were combed through to identify any possible patterns between students. Analysis of pre- and post-program surveys was conducted to identify the effectiveness of the summer exploration camps on improving attitudes and perceptions of personal health and interest in pursuing a career in the healthcare industry.

## Discussion

The aim of reviewing these studies was to determine the impact a summer exploration camp can have on the attitudes and perceptions of personal health and interest in pursuing a career in the healthcare industry. Students that participated in the camps were exposed to careers within healthcare while providing an opportunity to develop critical thinking skills and cultural competency. For example, students began camp completing a pre-test to measure initial attitudes and perceptions. Upon completion of the exploration, camp participants completed a post-test to measure the impact of the camp ([Grand Valley State University, 2022](#)). Overall, upon completion of the camp, more students reported having a positive attitude and greater interest toward pursuing a career in healthcare and felt confident that they could be successful in a healthcare career ([Grand Valley State University, 2022](#)).

A potential bias may contribute to a limitation in the study as participants attending these experiences may already be interested in pursuing a career in healthcare prior to enrollment. The focus on healthcare careers is communicated before enrollment into such exploration camps. The number of favorable responses on the pre-test could be a result of an existing interest (bias) in healthcare prior to completion of an exploration camp experience. The combination of small sample sizes within cohorts and previously existing interest in healthcare could potentially impact the outcomes.

## Implications

Exploration camps should continue to observe similar positive outcomes and are meaningful because they demonstrate the effectiveness of exploration style camps as a tool to educate and generate interest with minority populations. Communities throughout the United States are at risk for shortages in the healthcare workforce due to an aging population. Establishing pipeline opportunities for youth to explore and pursue health-related careers will be critical in the demand for diverse, healthcare workers in the upcoming generations. Summer exploration camps serve as a vehicle to expose youth to health

careers, generate interest in pursuing a college degree, and increase student efficiency in being successful in a health-related field overall. In particular, early exploration of these careers by minority populations can demonstrate how increasing knowledge surrounding various types of health careers can influence the career interest of students.

## Author contributions

RB, KA, and PD contributed to the conception and design of the study. RB, BS, and EP organized the literature review. RB, EP, and BS wrote the first draft of the manuscript. RB, EP, TS, and BS wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted final versions.

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